Synopsis

A Study on Intelligent Fashion Forecasting Systems: Frameworks and Empirical Validations

1. Introduction

"Only with Technology can you create new things in fashion, everything else has been done "

-Hussein Chalayan

Fashion is a fabulous industry which represents 14-15% of consumer spending globally (Technopak, 2017), and growing at a CAGR of 3-4% annually. From outside it is perceived as an industry with glamour, vibrance, beauty, money, fame, and massive profits, however from inside this is a wounded industry. An industry with a size of 3 Trillion USD, 150 Billion units of products per year (Apurba, 2019), the fashion industry is characterized by low shelf-life products, wrong forecasts, low inventory turnovers, frequent discounts, low realized margins and operating profits, and ever-increasing competition. Best of the fashion retailers make only 10 -11 % operating profits (Subramanian, 2014). Fashion is a terrible industry to be in from a return on investment point of view; often, brands and retailers bleed on margins. Deep discounting is a common practice in the fashion industry in the name of inventory dilution and adding freshness to stores and product categories; however, it burns the retailers' potential profits. Fashion industry is one of the few industries where products become psychologically obsolete (Sproles, 1981) and convert into terminal stock once the selling season is over (Easey, 2009). These phenomena of psychological obsolescence acts both in favour of brands and fashion retailers as well as against them. It creates a desire for newness amongst fashion consumers on the one side which fuels their fashion purchases. However, at the same time with the onset of a new fashion the old styles become outdated and hence, any such fashion leftovers on the retail shelves convert into potential profit killers. In the fashion business, the product is the central element of the marketing mix (Easey, 2009). If consumers do not like the product itself in the first place, no amount of marketing can help. Fashion consumers perceive the fashion product as an extension of their fashion identities

and not willing to compromise with it (Cranes, 2012). Hence, having the right product itself in the first place may provide a solution to one of the fundamental challenges of this industry. To forecast the right products, fashion brands and designers rely on fashion forecasters and related services.

Fashion forecasting is all about scanning the environment to spot upcoming trends, colors, fabrics, cuts, silhouettes, and designs. Forecasters are people who pick upcoming and prevailing trends from available resources (Popcorn, 1991). However, it is compared with chasing the future with a butterfly net (Gardener, 1995). Fashion trends change like the weather. What was selling in the previous season may vanish from the scene entirely. The conventional apparatus of fashion forecasting included trawling art exhibitions, restaurants, concerts, events, and even scientific journals, photographing trendy people, traveling to fashion cities, following catwalk shows and celebrities, and spotting vintage as well as upcoming trends. Fashion magazines such as Elle, Vogue, Glamour, Instyle, GQ, and Harpers Bazar, also play a significant role in providing inputs on various styles from fashion forwards to the masses. Other tools include scanning past sales data, supplier communication, competition mapping, environment scanning, consumer scanning, and fashion predictive scanning. However, irrespective of having the best resources and forecasting tools, fashion brands continue to face the heat of wrong forecasts. Few authors even compared the post-mortem-based forecasting approach after the season is over for the next season as a bad practice.

Every season, fashion forecasters are haunted with this same question "What will sell?"

In the present work we have attempted to answer the above-mentioned question in the light of some recent technological developments in this field. While we have challenged the existing popular theories of fashion forecasting on one side, the dissertation also prescribes and proposes few important as well as relevant frameworks which may be put into practice in future for developing consumer loving products.

We have documented the role of technologies like Artificial Intelligence, Machine Learning, Deep Learning, Human-Robot Interface, Artificial Neural Networks Natural Language Processing, which are surprisingly used by the fashion industry now a days. Surprisingly, our research explores evidence of massive technological interference in the field of fashion forecasting and product development in last few years. However, such evidences were not captured strongly in academic literature.

Few authors highlighted the role of some emerging developments like data on the internet, social media, e-commerce, and another web 2.0 applications. They apprehended that these might assist in forecasting. However, in the existing fashion forecasting literature, the extent of occurrence of such evidences are neither frequent nor firm. Though scattered pieces of evidences exist, the authors in this work felt there is a need to develop a framework in the light of these new developments.

On the other side, some new-age companies such as EDITED, StyleSight, Stylumia, WGSN+, and Promostyl use data from the internet to arrive at fashion decisions and provide intelligence inputs on product decisions to their customers. Their clients include the who is who of the fashion brands. Even mainstream technology companies such as Google, Microsoft, and IBM are researching these new developments and creating fashion clients' applications. We documented few of these new developments in the form of case studies and discussions.

We also explored that Social media have a lot to offer in fashion forecasting, particularly with applications like Facebook, Instagram, Twitter, Tumblr, and Pinterest which are generating tons of both random and discreate as well as structured and unstructured data. These applications are the warehouse of fashion data in the form of images. When users upload their pictures on these sites, they also offer a sneak peek into their clothing choices. Hence, we felt the need for a framework to analyze these pieces of information to create intelligence on fashion products in real-time. A framework-based approach for forecasting fashion from social media, e-commerce and other web data was missing in existing literature even though many related works existed. We filled this gap in literature through this dissertation and with related publications in reputed academic journals.

The present work's central objective has been towards creating a framework of e-forecasting for the fashion industry. The peripheral objectives also cover emerging areas such as Artificial Intelligence usage by fashion companies and a framework for this, internet-based fashion forecasting or short term forecasting or 'nowcasting fashion,' connecting elements such as fashion identity, which justifies why data on the internet and particularly social media can be purposeful for forecasting fashion. We discussed how identity is the connecting element between fashion consumption and social media. Users reveal their identity through social media and fashion consumers through their products. Hence, when social media users are also fashion consumers, decoding their communications may better understand their

consumption. The issue has been deliberated well and investigated through a case study in the present work.

The present study identified multiple gaps in the existing literature which were later used to form objectives, hypothesis and research questions. These are presented below in this synopsis under relevant sections and headings.

Fashion is a highly skewed industry on the profitability side. In a study by McKinsey (2019), on a sample size of 500 fashion retailers the top 20% of companies in fashion commanded an average profit of 128%, the next 60% made 6% profits, whereas the last 20% companies made -34% (negative) profits in the year 2017. The same report tells, only the top 20 companies in the fashion industry contributed to 97% of profits in 2017, making the fashion business highly skewed towards super performers when it comes to profitability. There are evidences in literature that most of the super-performers among fashion brands are using technologies like AI, Machine learning, Artificial Neural Networks, Human Machine Interface etc. A recent article in Forbes (Schmelzer, 2019) reports that technology has the most significant impact on fashion industry. Using technology like A.I. for product development can reduce the forecasting error, up to 50% in the fashion industry. Subramanian (2014) outlined that by reducing forecasting error by 5%, profitability can jump by 25-30%. Standish and Ganpathy (2018) emphasized the same but added that A.I. might bring inventory levels down by 20-50%. Hence, using a technology like AI may certainly bring a host of benefits for the fashion industry.

However, for a country like India where fashion business majorly consists of unorganised standalone retailers who are far from any form of sophisticated technology usage, right product development remains a great challenge. Majority of them might not be able to invest or sustain the cost of such a technology.

We have addressed these issues in the present work. Our primary objective is to develop a framework of e-forecasting for fashion industry. We validated this with a case study of an Indian unorganised fashion retailer. We did not use any AI tools while collecting or processing data. We suggested one of the many ways which even small standalone retailers might use for environmental scanning (digitally) and arrive on intelligent fashion decisions.

In our second framework we argued for intelligent fashion forecasting system using AI tools. We used a case study of world's first fashion intelligence company to deliberate on their

techniques and processes. We validated this proposed framework by drawing the conceptual framework of the case study and matching it with our proposed framework.

The present dissertation may have theoretical contributions, practical implication, methodological contribution as well as future research directions which have been documented below.

2. Rationale for the Topic (Research gaps)

The choice of the topic has been guided by several factors in this piece of work. Firstly, a broad area of fashion research was chosen for an in-depth literature review based on researchers' background, interest and prior experience. After a holistic review of the field, research gaps were identified. This led to development of objectives, research questions in the later stages. While choice of gaps was motivated by unavailability of any academic literature in the mentioned areas, objectives were drafted carefully based on availability of resources, methodological apparatus, data, time and finally the novelty of contributions that the research was trying to make.

Several gaps were identified after a careful and systematic review of literature.

Firstly, there was a dearth of literature observed in the area of fashion identity. The term itself appears to be an under-researched term in the research literature, though its relevance and importance has been highlighted in some previous studies. Concepts of self-identity and social identity and their relationship with fashion identity through a conceptual design were absent in the previous literature. We realized that self-identity itself is a significant construct for defining the fashion motivations of individuals. However, existing literature was limited in this area.

We observed that literature in the area of fashion forecasting is quiet outdated. It does not include the recent developments, methods and technological tools. We found that a systematic literature review in digital fashion forecasting or e-fashion forecasting was yet to be carried out, significantly when the area is rapidly growing in an industrial context and fast emerging in academic texts. Some of the emerging tools like artificial intelligence, machine learning, deep learning, human-robot interface, etc., were noticed to impact the area of fashion forecasting profoundly; however, a framework and systematic documentation was

found to be missing in the pertinent literature. There is little evidence in the existing literature on developing a fashion product based on social media and e-commerce data, especially image analysis. Even though few works exist, none of them attempted to forecast fashion products in the light of empirical evidence.

In the present work, these gaps are addressed. Through this work, we have not only addressed a novel field, but asked novel questions, developed novel methods and derived novel findings.

3. Objectives

The present work addresses four objectives which are as follows:

- To develop a conceptual framework of Fashion product e-forecasting and empirically validate it.
- To develop a conceptual framework of fashion forecasting using artificial intelligence and empirically validate it.
- To propose a framework of short-range fashion forecasting.
- To develop a framework of fashion identity and explore its relationship with self-identity and social identity.

The first objective being the primary one. Co-objectives were obtained and attained in the process of addressing the primary objectives.

4. Hypothesis

The present study is based on four hypotheses. They are as follows.

- Internet data is being used by fashion industry for fashion forecasting and develop fashion products.
- Artificial intelligence and machine learning are assisting in fashion forecasting.
- Short range fashion forecasting is being done by fashion industry using a variety of tools and sources.

- Every fashion consumer has a unique fashion identity which guides his fashion consumption and behaviour towards online engagement.

5. Research Questions

The research questions of the present study are represented below:

- How data from internet, social media and e-commerce websites may be used to guide fashion forecasts?
- What is the effect of emerging technologies like artificial intelligence on the field of fashion forecasting?
- How to forecast fashion trends in the short range? What factors/tools constitute short range or short-range fashion forecasting?
- What constitutes fashion identity of a person? Why a person consumes fashion? What are the fashion motivations behind engaging in social media and e-commerce? Why a person's online behaviour may be able to explain his choice of fashion products?

6. Methodology

A rigorous methodological approach has been carefully drafted and implemented in the present study to fulfil our study objectives and arrive on findings. We first proposed few frameworks and conceptual models. The primary frameworks associated with our primary objectives were later subjected to empirical investigations through two different case studies. The objectives of both these case studies were to investigate on the extent of implementation of the related framework in the industry in the light of primary data. The primary data used in both the case studies is qualitative (Interviews, observations, photographs, webpages, social media pages etc.) however in the second case study, we presented a novel method of analysing qualitative data such as pictures and images of consumers retrieved from their social media pages (mainly Facebook in the current study), coded them into quantitative data using a technique called 'effect coding', processed it through a popular data analytics software SPSS using a widely acceptable analysis method 'cluster analysis' and reverse coded the output to retrieve popular clusters of fashion products which consist of widely accepted

consumer attributes and labels. Both these case studies validated our proposed frameworks of fashion product development.

We have done our investigations using both qualitative and quantitative research methods in the given study. The data used is primarily qualitative, however it was converted into quantitative data and processed in the same manner.

Our research methods are novel and not been used in previous studies.

6.1 Theoretical and conceptual frameworks and models

We derived three conceptual frameworks and one conceptual model in the given work. A detailed discussion on frameworks and models is given in chapter 3.2. The frameworks and models derived are as follows:

- Conceptual Model of Fashion Identity
- Framework of Short-range fashion forecasting
- AI framework of fashion forecasting
- Fashion Intelligence Framework of fashion e-Forecasting

A detailed discussion on how the frameworks are developed as well as their relevance in the present context are discussed in the respective chapters.

6.2 Data Sources

To validate some of the frameworks mentioned above, primary data has been collected through case studies. We developed two case studies in the present work titled “Stylumia: Artificial Intelligence in Fashion” and “Nowcasting an Indian Kurti using Facebook photographs of consumers”. For developing the first case study, data corresponding to the company, activities the company is doing, definitions of those activities, description of context and relevance, output, and implications of those activities has been captured through multiple data sources. These sources include online /articles/publications and news articles, in-depth interview of the founder using a semi-structured questionnaire and observation on social media, webpage and homepage of the company.

For the second case study, our data source has been primarily Facebook photographs of consumers posted on their wall in a given time frame under a given criteria (defined in the case study).

6.3 Sampling Design

The first case study used by us is a qualitative one which is made on just one company. The case study is exploratory in nature and evaluates the steps and processes followed by the company vis a vis framework proposed by us.

In the second case study we have actually collected consumers' data using a combination of Purposive and Simple random sampling (SRS), an internet data collection technique called 'Netnography' using observations on consumer Facebook pages. Our sample size is 176 with sample selection criteria being presence of a particular outfit in complete visibility (Kurti), willingness to participate in the research, number of pictures posted in a given timeframe, and clarity of the pictures.

6.4 Analysis

In the first case study we have used qualitative data and qualitative analysis whereas in the second case study we have done qualitative data and quantitative analysis (Tracy, 2012).

In the first case study, qualitative data from multiple sources was captured, transcripts were made, themes were noted, frameworks were developed and presented in the form of a case study. In the second case study we converted qualitative data into quantitative one using a technique called 'double coding' (Krefting, 1991). The data corresponding to attributes and labels of a popular fashion product (Indian Kurti) was converted into binary numbers (0 and 1) for their presence or absence. We further processed this on a popular statistical software SPSS 22.0 using first Hierarchical cluster analysis followed by K-means clustering. We used wards method of linkage and Euclidean distance measures. The choice of the tools has been justified in detail in the relevant chapters in this work. The output was generated and converted back into pictures using fashion illustration or sketching of the newly formed products.

7. Findings

The present work may have multiple findings. Firstly, we have documented the usage of AI tools in the fashion forecasting process. We propose and validate that primarily there are four AI tools which the fashion industry is using. They are Machine Learning (ML), Deep Learning (DL), Natural Language Processing (NLP) and Artificial Neural Networks (ANN). Our framework documents the process of fashion product development using these tools.

Secondly, we have demonstrated how a fashion product may be developed using internet-based data. Without using any of the AI tools proposed above, we devised a novel method of product development using social media data. We also proposed the framework of short-range forecasting which will gain higher relevance in future. Through our framework of fashion identity, we proposed the conceptual model which explains the fashion motivations of individuals and answered why people like to indulge in fashion.

8. Contributions/Outcome

The present work may have theoretical contributions, methodological contributions, practical implications and may give future research directions.

Among theoretical contributions, it might contribute novel theory in the area of fashion forecasting, digital tools in fashion forecasting, fashion identity, short range forecasting etc. It also explains how upcoming technologies like AI, ML, DL, Machine vision etc. are creating a paradigm shift in the fashion industry.

We have proposed a novel method of fashion forecasting and named it as fashion 'nowcasting' in the present work. From Social media pictures of fashion consumers, we have extracted fashion trends and forecasted new and upcoming products. Use of coding, clustering, Netnography etc. form a new set of methodological contributions in fashion research. Practically our work may have much larger significance. It may solve some of the core problems of fashion industry like low inventory turnover, frequent discounting, higher stockouts, low sell through rates, low maintained margins, incorrect pricing, inaccurate products, fluctuating consumer preference and decreasing satisfaction.

This work may give further direction to the area of fashion forecasting and product development using present day digital tools and data driven technologies. In future, a host of

researchers may try to solve similar problems using identical tools, our work may be a milestone for future researchers in this area.

9. Conclusion

The present work is a rigorous attempt to document some of the futuristic developments in the fashion industry into academic literature. Frameworks and theory generated in the area of fashion forecasting and technology will be relevant for quite a long time. The fashion industry is changing rapidly with the onset of technology. We noted many developments particularly in recent years, which caused a long-term impact on the way fashion brands do their business. Such developments featured poorly in academic literature. Through this work we filled that gap. We propose some of the new tools which fashion retailers are using to develop products. We also propose novel methodologies of fashion product development using internet data. This work may motivate future researchers to contribute in this area. They might use some of the frameworks developed by us to solve new research problems and ask new research questions.

10. References

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